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THE PRINCIPLES and PRACTICE
of
OCULAR PHYSICAL THERAPY
for
OPTOMETRISTS
by
DR. JACK I. KURTZ

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A PHOTOGRAPHIC STUDY OF THE BINOCULAR BEHAVIOR OF EYES HAVING MONOCULAR AND BINOCULAR ABNORMALITIES*

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Introduction

The first important work on the physiological psychology of eye movements was carried on in 1878 by Louis Emile Javal (13), the noted Parisian ophthalmologist. However, he was preceded by Lamansky (16) who used the crude after image method to determine the angular velocity of eye movements. A small beam of light interrupted at regular intervals was flashed into the eye as it moved through a given arc, and the speed of movement was determined by counting the number of after images present following the movement. This method was also used by Erdmann and Dodge (10). Javal was probably the first to notice that the eyes move in jerks or saccades.

Ahrens (1) devised one of the earliest methods to show eye movements during reading. He set a form fitting ivory cup on the cornea of a strongly cocainized eye. The cup carried a very small mirror that served as a reflector and threw a beam of light onto a screen where its movements could be observed. This method was, of course, limited to few subjects and slow ocular movements. Delabarre (6) used a plaster of Paris cup similar to Ahrens' but attached a metal ring to the cup and recorded the eye movements on a kymograph drum. In spite of the crudity of the method, Delabarre was able to get some idea of the time relations of eye movements and fixations.

Dodge and Cline (8) introduced a great improvement in technique by incorporating 5 requirements for a satisfactory eye movement apparatus, namely, 1. the apparatus must operate under normal binocular vision; 2. it must register both eyes simultaneously; 3. the unit of measurement must be one sigma or less; 4. the registering media must have no inertia and the eye must perform no extra work due to the mechanism; 5. the apparatus must permit the measurement of a large

*An abridgment of the material presented before the American Academy of Optometry at New York, N. Y., August 25, 1935.

number of eyes without serious inconvenience. To accomplish this they flashed a beam of light into the eye. The beam was interrupted at regular intervals so that the exact time could be determined when the beam was photographed on a plate moving at a constant speed. This method gave an objective photographic record of the ocular movements. Since that time numerous modifications of this method have been devised and used, and a considerable amount of experimental data have been gathered in relation to reading. However, surprising as it may seem, very little experimental work has been carried on to determine the binocular behavior of the eyes. This has been due chiefly to the fact that monocular photographic records are sufficient to determine the duration and number of the fixations and regressions during reading. Therefore, until recently, apparatus has not been devised to record vertical and horizontal movements of both eyes. Cameras have been constructed at the University of Iowa (14) and at the University of Southern California (2) which will do this, and the latter has the advantages of high magnification of movement and that the data obtained are on a single record.

The technique of eye movement photography has resulted in a number of experimental findings which bear on the problem at hand. McAllister (17) using the kinetoscopic technique made an extensive study of visual fixation. He found that the image of a point fixed does not fall on any particular point of the retina, but it may fall on a considerable area around about and including the fovea centralis. He also found that the same elements are not stimulated on successive fixations and that the movements of the two eyes in passing from one point to another are not coordinated. His results show that there is no "law of fixation" and that the mechanism of fixation is more or less random.

Dodge (7) made an extensive study of visual fixation using the corneal reflection method and found results similar to those of McAllister. He concluded that a functional center in the sense of a retinal point does not exist and points out that extra-foveal fixation is quite common, for example in dark adaptation. He believes that the important question in psychological optics is not so much the mythical fixation point as the interrelation between areas of more or less distinct vision. He defines adequate fixation as fixation which gives clear perception.

Judd (15) using an improved type of kinetoscopic camera made a study of convergence and divergence movements. The lack of harmony was an outstanding characteristic of all of the subjects. In some cases, the right eye was the faster and in some cases the left. The less acute eye made the most rapid movements, and the eyes showed conjugate movements prior to convergence movements. In convergence he found that there was a tendency to over-shoot the mark and concluded that binocular vision is a result of coordinating or unifying various percepts.

Since the work of Schmidt (21) in 1917, there has been little work done on the binocular behavior of the eyes during reading. Schmidt

found that during interfixation movements and especially during the return sweep to the beginning of the line, the eyes make upward and divergence movements which necessitate downward and convergence movements during the fixation pauses. Clark (4) found as did Schmidt that the eyes moved up during the return sweep to the beginning of the line but that almost without exception the eyes over-converged in moving from the end of one line to the beginning of the next. Clark also found that there was a tendency for individuals having high exophoria to make larger over-convergence movements. In another study Clark (5) also found that there is, within certain limits, a linear relation between the size of these over-convergence movements and the interfixation distance. In both of these studies marked variations in the behavior of one eye as compared to the other were found.

Peckham (20) made a study of the binocular variations in fixation using the method of direct observation with a telescope and found marked discrepancies in the fixation of the two eyes. These discrepancies amounted to as much as 10△ and throw into question theories of corresponding retinal points. Clark (3) using the photographic technique obtained similiar results in studying stereoscopic vision and showed that an area on the retina as large as 1.5° (much larger than the macula) may be used to fix a point.

The direct practical importance of photographic studies of the behavior of the eyes has been indicated by the work of Clark (4) as shown above. Other investigators have become very much interested in the problem of binocular irregularities and reading. Eames (9) has found that reading disability cases show a higher per cent of exophoria than do normal individuals. Selzer (22) even goes so far as to state that eye muscle imbalance, alternating vision and lack of fusion account for such reading disabilities as are not accounted for by general mental disability. Farris (11) presents data which tend to show that one eyed individuals make greater progress in reading than do normal individuals and explains the results as due to the fact that these persons do not have to make the more complex binocular adjustments. On the other hand Fendrick (12) working under Gates at Columbia, came to the conclusion that reading disability cases have no more eye defects than do normal individuals. Of course the subject is much more complex than this simple statement. For example, one eyedness is a defect but may be an advantage in reading, as indicated above. The same thing is true of myopia. It has been known for years that myopes as a whole will be good readers and like to read.

The Problem

As indicated by the brief summary of the results of certain eye movement studies, it appeared that a study of binocular eye movements of certain cases having marked abnormalities of the visual functions would be of value. This study was planned as a preliminary investigation of this problem and would appear to have possible value from two points of view: first, from the light it might throw on the theoretical aspects of binocular vision, and second, from the point of view of the

investigation of a method which may have application as a diagnostic instrument in regular practice. Eye movement photography presents, potentially at least, an objective method for the practicing eye specialist, and as much more data are gathered in relation to the binocular behavior of normal and abnormal eyes, it may come into general use, for purely objective techniques are in the minority in visual tests.

Apparatus and Procedure

The subjects used in this investigation were obtained through the cooperation of several optometrists in Los Angeles.[1] Several of the subjects showed high exophoria (14-24△) at the reading distance, and one of these also had a vertical imbalance associated with the exophoria. Four other subjects were selected because they had reduced vision in one eye and were unable to read the print used in the experiment. Two of the subjects were fifteen years of age, and the others ranged from 20-35.

The apparatus used to photograph the eye movements was one previously described by Clark (2). This instrument gave records of the horizontal and vertical movements of both eyes on a single record with high magnification. The adult subjects read two paragraphs from the introduction to Students' Guide for Demonstration of Psychological Experiments by Milton Metfessel. The length of the lines was 15 cm., the type was 10 pt. Caslon, and the reading material was placed approximately 33 cm. from the subjects' eyes.

Part of the subjects also changed their fixation between words placed at different interfixation distances. The following eight words were used at 4 interfixation distances: 1. have-save, with an interfixation distance of 26.42°, 2. atom-they, interfixation distance 20.60°, 3. know-gone, interfixation distance 14.32°, 4. kind-been, interfixation distance 8.61°. These words were also printed in 10 point Caslon. The subjects changed their fixation between them keeping time with a metronome beating 90 times per minute. The whole testing procedure lasted on the average approximately 20 minutes, and the order of the presentation of the material was changed at random from subject to subject. A total of over 1200 ocular movements were photographed and analyzed for this study.

Results

The photographic records were studied to determine the characteristics of the eye movement habits of these subjects so that they could be compared with similar findings for "normal" individuals. In all cases each movement was measured directly with a millimeter rule or dividers and a millimeter rule. In each case the measurement was made to the nearest ½ mm. and any displacement less than ½ mm. was considered a part of the fixation. A displacement of ½ mm. on the film represented an ocular rotation of approximately 0.7△.

1. Appreciation is due to the following for their cooperation in obtaining subjects: Drs. Irma Kasten, Robert Orr, E. F. Richardson, and Arene Wray.

1. Reading

(a) Fixations and regressions.

First, a tabulation was made of the number of fixations and regressions per line as well as the reading time per line. These results were compared with those of a control group (4) upon which similar measurements were made. The results are summarized in Table I.

TABLE I.

A Comparison of the Reading Scores for the Two Groups for the Usual Reading Measurements.

	Experimental Group	Control Group
Reading time per line in seconds	3.33±0.55	3.35±0.59
Average number of regressions per line .	0.85±0.63	1.00±0.63
Average number of fixations per line . .	11.50±1.85	13.81±1.60

It can be seen from these results that the average reading time per line for the two groups was practically the same. The same thing held true for the variability as shown by the probable error. The average number of fixations and regressions was only slightly less for the experimental group. In other words, as far as the usual measurements made in eye movement studies are concerned, these two groups were comparable.

(b) Binocular adjustments.

The binocular adjustments were analyzed in a manner similar to that of a previous study (4) described above. The average magnitude of the divergence movements at the beginning of the lines was found to be 111.6±38.0′ (3.3△) as compared to 30.0±9.5′ (0.9△) for the control group. In other words, this group of high exophores and those having low vision in one eye over-converged in moving from the end of one line to the beginning of the next on the average 81.6′ (2.4△) more than a control group having "normal" vision and "normal" binocular balance. This in turn required a divergence adjustment of 3.2° at the beginning of the line on the average, and in some cases the movements were as large as 315.0′ or 9.16△.

Three of the four cases of low vision made greater divergence movements with the poorer eye and the other case made greater divergence movements with the better eye. All of the exophoria cases (5) made, on the average, greater divergence movements with the non-dominant eye as measured by the Miles V-scope technique (18). However, in this respect there was considerable variation. In the individual cases one eye would move as much as 170.4′ (5.0△) more than the other eye.

The time required to complete the divergence movements was also determined. For the experimental group it was found to be 4.26± 0.68/25 seconds as compared to 2.34±0.55 for the control group. This difference of 1.92/25 seconds is probably significant. In this respect also,

there was much individual variation between the 2 eyes, i.e., one eye would fix while the other eye was moving and in all probability the fixing eye was doing most of the clear seeing at this time.

Taylor,[1] in Texas, found that sometimes the eyes have a tendency to diverge in reading a line. The records were examined to determine the extent of these movements in the experimental and control groups. The divergence between the second and last fixations was measured in order to eliminate the initial divergence. The results were obtained on the basis of ½ mm. displacements on the record and are tabulated in Table II.

TABLE II.

The Divergence of the Two Eyes from the Second Fixation to the End of the Line.

Extent of divergence	% of control group	% of Exp. group
0.0′	85.3	68.0
24.0′	14.5	19.0
48.0′	0.2	12.5
72.0′	0.0	0.5

It can be seen from the table that these movements occurred in both groups but were more frequent and greater in size in the experimental group. This divergence is due in part to the fact that there is a difference between the two eyes in the saccadic movements and also that there is a difference in the fixation movements.

The extent of the vertical movements was also determined. The average for the experimental groups was found to be 83.4′ with a range from 0-291.6′ and for the control group 65.0′ with a range from 46-135′. In other words, on the average the abnormal group made larger and more varied responses. The average time to complete the vertical component of the movement was 2.7/25 seconds, i.e., on the average the vertical component of the movement was completed in approximately one-half the time required to complete the divergence component.

One or two examples will serve to show some of the discrepancies in the binocular behavior of the eyes in reading. The right eye of subject Eb at the beginning of one line completed the vertical adjustment in 4/25 seconds with the right eye while the left eye, (the one with poor vision) completed the vertical component in 65/25 seconds or nearly at the end of the line after approximately 10 fixations were made within the line. In spite of this fact the left eye made a definite convergence movement at the beginning of the line amounting to between 3 and 4 diopters.

One case of high exophoria showed a divergence movement of the right eye amounting to 24′ while the eye moved down 55′. At the same time the left eye diverged 96′ and moved down 55′. These examples are

1. Reported in private conversation with the writer.

the rule rather than the exception in the binocular behavior of abnormal eyes. In other words the eyes do not ordinarily move symmetrically. This is especially true of abnormal eyes. Irregular and asymmetrical movements are the rule rather than the exception. From a theoretical point of view, these findings throw into question theories which attempt to explain binocular phenomena on the basis of a strict retinal correspondence. From a clinical or practical point of view they stress the importance of a careful analysis of eye exercise or training devices on the basis of what abnormal and normal eyes are doing in the routine business of seeing.

2. Simple interfixation movements.

The data for simple interfixation movements were also examined to determine the characteristic eye movement habits of the abnormal group. It was found as had been found in a previous study that the eyes make two definite types of horizontal corrective movements during the initial part of the fixation. 1. Corrective adjustments which are necessary because the eyes almost without exception fell short of the mark, and 2. Divergence adjustments because the eyes over-converged during most of the major movements between 2 points. Associated with these horizontal movements there was also a downward adjustment to correct for an upward movement during the saccadic movement between the 2 points.

(a) Corrective movements. The data obtained from both the exophores and those subjects with low vision in one eye were substantially the same. The data for the two groups were first combined and compared with those of the control group. Both are summarized in Table III.

TABLE III.

The Average Size of the Corrective Movements at Four Interfixation Distances

	Average size of the convergence movements			
Interfixation distance . .	26.42°	20.60°	14.32°	8.61°
Experimental group . .	84.6′	55.9′	36.9′	23.1′
Control group	65.7′	75.3′	29.1′	17.5′

It can be seen that for the experimental group there is practically a linear relationship, within the limits of the study, between the extent of the corrective adjustment and the interfixation distance. This corroborates the findings of the control group which were obtained from another study (5). It can also be seen that there is no consistent difference between the two groups. The differences themselves are not statistically significant because of the large variation in the behavior of the eyes between individuals and also because of the high individual variation.

(b) Binocular adjustments. The divergence movements at the beginning of the fixation pause were also measured. These data with those of a control group are tabulated in Table IV.

TABLE IV.

The Average Magnitude of the Divergence Adjustments at Four Interfixation Distances

	Average magnitude of divergence movements			
Interfixation distance	26.42°	20.60°	14.32°	8.61°
Experimental group	103.2±46.2′	94.8±32.7′	79.2±30.9′	51.6±43.2′
Control group	84.5±22.5′	67.1±28.2′	42.3±22.3′	28.7±12.3′

These data show that the "abnormal" group consistently makes larger divergence movements at the beginning of the lines. In other words the exophoric group is consistent in making larger over-convergence movements in moving the eyes from one point to another. This means that the exophoric individual is getting base-in training on the average of 3△ every time the eyes move through an arc of 26°, and if the movement is larger the corrective movements are probably larger. Over-convergence movement as great as 6△ are not at all uncommon. Such individuals certainly do a considerable amount of over-converging and the resulting fatigue from such "training" is something worth considering when base-out training for exophoria is being considered. In this study no attempt was made to check on fatigue, but there would be a worth while research problem, i.e., to determine where and how the breaking down process occurs. The work of Miles (19) making tests on one eye is suggestive of the findings for both eyes. This might lead to an objective method of measuring binocular fatigue.

These data also corroborate the findings of a previous study in indicating that there is a linear relation between the interfixation distance and the size of the divergence movements, i.e., within the limits of this study the size of these corrective movements increases as the interfixation distance increases. The time required to complete these divergence movements was also determined, and the data are summarized in Table V.

TABLE V.

The Average Time in 1/25 Seconds Required to Complete the Divergence Movements

	Average time to complete the divergence movements			
Interfixation distance	26.42°	20.60°	14.32°	8.61°
Experimental group	4.79±1.43	4.99±1.66	4.91±1.12	4.31±1.24
Control group	5.62±0.71	5.61±0.92	5.92±0.72	5.65±0.74

These data tend to indicate that the divergence movements of the control group were slightly slower than those of the experimental group, but the high P.E. shows that the difference is probably not significant. The experimental group was consistently more variable. For this group on the average, it required approximately 5/25 seconds to complete the divergence movement, but in certain cases the time was as much as 11/25 seconds although this did not occur frequently.

(c) Vertical movements. The vertical components of the corrective movements at the beginning of the fixation pauses were also measured, and the results are summarized in Table VI.

TABLE VI.

The Magnitude and Time of the Vertical Movements Average Time Required to Complete the Vertical Component in 1/25 Seconds

	Average magnitude of the vertical component			
Interfixation distance	26.42°	20.60°	14.32°	8.61°
Experimental group	115.8±36.7′	109.8±23.4′	103.2±45.6′	49.5± 5.8′
Control group	75.0±25.4′	69.0±20.9′	59.0±22.7′	51.6±20.9′
D/P.E. diff.	4.1	4.7	2.8	0.3

	Average time required to complete the vertical component in 1/25 seconds			
Interfixation distance	26.42°	20.60°	14.32°	8.61°
Experimental group	6.1±1.0	6.2±0.9	5.2±1.3	4.7±1.8
Control group	2.4±0.9	2.7±0.7	2.5±0.9	2.2±0.8
D/P.E. diff.	7.1	7.3	3.9	3.1

These data tend to show that as a whole the vertical adjustments of the experimental group were larger and required more time to be completed. However, for small interfixation distances the differences were slight. These downward movements were the result of an upward movement during the change from one fixation point to the other. In other words in moving between two points the eyes moved up and converged which required a downward and convergence movement to "fuse." The vertical component of movement was as large as 240′ (7△) in some cases and required as long as 13/25 seconds to be completed.

One interesting record was obtained from a subject with hyperexophoria which at times became a tropia. He had some control over his fusion, but the record was taken when he was trying to fuse the words at the beat of the metronome. However, he was unable to do it at any time during the trial which included the 2 smallest interfixation distances. Divergence movements as large as 7△ occurred in the horizontal meridian and divergence movements amounting to 4△ were common. Vertical movements of the two eyes differed as much as 5△ in attempts to fuse, i.e., one eye would make a very large movement while the other eye moved only slightly. Simultaneous and symmetrical movements of the two eyes in the vertical meridian occurred frequently. In spite of the lack of fusion the general pattern in moving from one point to the other was up and converging, and divergent fusion movements occurred in spite of vertical discrepancies.

Summary and Conclusions

Over 1200 ocular movements were photographed using the corneal reflection method to determine the characteristic eye movement habits of individuals having high exophoria or poor vision in one eye. This group was compared with a control group consisting of individuals having standard vision and "normal" binocular balance. The investigation resulted in the following specific findings:

1. During the reading period the experimental group did not differ significantly from the control group in the number of fixations, regressions, and reading time per line.

2. The experimental group on the average made larger over-convergence movements in moving from the end of one line to the beginning of the next. These movements were as large as 9△ for one individual in the experimental group.

3. The experimental group required more time to complete the corrective divergence movements at the beginning of the lines than did the control group.

4. The vertical component of the corrective movement was also larger for the experimental group.

5. The experimental group showed a greater tendency for the eyes to diverge while the individuals read through a single line.

6. In shifting fixation between two words, both groups showed a linear relationship between the size of the corrective adjustments and the interfixation distance.

7. The experimental group made larger divergence adjustments after simple saccadic movements. The time required to complete these adjustments was also greater for the experimental group.

8. For large interfixation distances the experimental group made larger vertical corrective adjustments than did the control group.

9. The experimental group was consistently more variable than the control group.

Aside from their theoretical implications, these results point to the possibility of eye movement photography as a diagnostic aid in clinical work although much data must be accumulated before such a thing can be put into practical use. This method has the distinct advantage of giving an objective record of the behavior of the eyes while they are performing routine visual tasks. A priori such data should be expected to be of value clinically, and this preliminary investigation indicates differences between normal and abnormal eyes can be determined by such a test.

This study also shows that both normal and abnormal eyes are being continuously subjected to "fusion training" not only in reading but constantly in moving from one point to another. It also indicates that the "abnormal" individual is getting more severe "training" than the normal individual and throws into question the value of giving "base-out" fusion training for a few minutes per day when the individual is getting "base-in" training for the remainder of his waking day. It may even suggest the possibility, in some cases at least, that the subject may actually be making divergent fusion movements when convergence fusion training is being given, if the training involves interfixation movements. These findings show the importance of a most careful analysis of eye training devices to determine exactly what happens to the eyes during the training period.

BIBLIOGRAPHY

1. Ahrens, A., "Untersuchen ueber die Bewegung der Augen biem Schreiben," Inaugural Dissertation, Rostock, 1891.

2. Clark, B., "A camera for simultaneous record of horizontal and vertical movements of both eyes," *Amer. J. Psych.*, 1934, *46*, 325-6.

3. Clark, B., "An eye movement study of stereoscopic vision," to be published in the *Amer. J. Psych.*

4. Clark B., "The effect of binocular imbalance on the behavior of the eyes during reading," to be published in the *J. Educ. Psych.*

5. Clark, B., "The effect of interfixation distance on binocular fixation movements," to be published in the *J. Exper. Psych.*

6. Delabarre, E. E., "A method of recording eye movements," *Amer. J. Psych.*, 1897-8, *9*, 572-4.

7. Dodge, R., "An experimental study of visual fixation," *Psych. Mono.*, 1907, *8*, 1-95.

8. Dodge, R. and Cline, T. S., "The angle velocity of eye movements," *Psych. Rev.*, 1901, *8*, 145-157.

9. Eames, T. H., "Eye defects in reading disability," *The Eye, Ear, Nose, and Throat Monthly*, 1931, *10*, 124-5.

10. Erdmann, B. and Dodge, R., "Psychologishe Untersuchungen ueber das Lesen auf experimenteller Grundlage," Max Niemeyer, Halle, 1898.

11. Farris, L. P., *Visual Defects as Factors Influencing Achievement in Reading*, Ed. D. thesis, University of California, Berkeley, 1934.

12. Fendrick, P., *A Study of the Visual Characteristics of Poor Readers*, Doctorate Dissertation, Columbia University, 1935.

13. Javal, E., "Sur la physiologie de la lecture," *Annales d'oculistique*, 1878, *79*, 97-117; 240-274.

14. Jasper, H. H. and Walker, R. Y., "The Iowa eye movement camera," *Science*, 1931, *74*, 291-4.

15. Judd, C. H., "Photographic records of convergence and divergence," *Psych. Mono.*, 1907, *34*, 370-433.

16. Lamansky, S., "Ueber die Winkelgeschwindigkeit der Blickbewegung," *Pfluger Archiv*, 1869, *2*, 418-.

17. McAllister, C. N., "The fixation of points in the visual field," *Psych. Mono.*, 1905, *7*, 17-81.

18. Miles, W. R., "Ocular dominance as demonstrated by unconscious sighting," *J. Exper. Psych.*, 1929, *12*, 113-126.

19. Miles, W. R., "Horizontal eye movements at the onset of sleep," *Psych. Rev.*, 1929, *36*, 122-141.

20. Peckham, R. H., "An objective study of binocular fusion: Preliminary report," 43rd Annual meeting *Amer. Psych. Assoc.*

21. Schmidt, W. A., "An experimental study of the psychology of reading," *Supp. Educ. Mono.*, 1917, *1*, iv+125.

22. Selzer, C. A., *Lateral Dominance and Visual Fusion*. Studies in Educ. Psych., Harvard University Press, Cambridge, 1933.

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HUMAN RETINAL SYNAPTIC FUNCTIONS: SUMMATION AND INHIBITION*

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Introduction

In a recent paper the author (1) has briefly outlined some of the general considerations dealing with synaptic functions in the retina and has presented evidence on the spatial summation of retinal excitation in the human eye under conditions where the intensities of the stimuli are subliminal.

The present investigation is concerned with the demonstration and description of another typical synaptic process—inhibition. The data of previous experiments on retinal inhibition are not so conclusive as those on summation (Graham and Granit, 6; Geldard, 5; Roaf, 8; Spencer, 9). In view of the equivocal state of affairs concerning the question of retinal inhibition, it was decided to determine just what effect a supraliminal stimulation of one area of the retina may have upon the threshold of an adjacent area when the conditions of stimulation are such as to control more adequately for possible adaptation effects. [For a more detailed description of this investigation the reader is referred to (2).]

Experimental Procedure

The apparatus used in these experiments was constructed so as to allow the presentation of flashes of light of 0.017 second's duration. The stimulus patches used for the foveal and binocular experiments were squares, the side of each square subtending a visual angle of 10 minutes. Those used for the peripheral experiments were squares, the side of each subtending a visual angle of 30 minutes.

The method which has been used is the following. The threshold of one area of the retina is determined. Threshold determinations are then made for the same area when an adjacent area is stimulated simultaneously with it. This procedure is repeated for various intensity sittings (supraliminal) of the inducing patch. Similar determinations are then made under conditions of varying spatial separation of the patches. For

*An abridgment of the material presented before the American Academy of Optometry at New York, N. Y., August 27, 1935.

the foveal experiments four separations were employed—ranging from 3.5 to 17.2 minutes of visual angle. For the peripheral experiments two separations, 50 and 130 minutes, respectively, were used.

Each subject was dark-adapted 5 minutes prior to the beginning of the foveal and binocular experiments, and 45 minutes prior to the beginning of the peripheral experiments.

Results and Conclusions

The results upon which the interpretation in terms of inhibition is based show that, under certain conditions of simultaneous stimulation of the two areas (in both the fovea and periphery), the threshold value for the test area is higher than its value obtained when presented alone. The essential condition for its demonstration is that the intensity of the inducing patch must be considerably above threshold.

With increasing degrees of intensity of the inducing patch the inhibitory effect becomes more marked. The degree to which the intensity of the inducing patch must be raised in order to produce an inhibitory effect in the fovea is less than that required to produce a similar effect in the periphery. Further, the results show that the amount of this inhibition is also a function of the distance separating the two patches—the inhibitory effect increasing as the distance between the patches decreases.

When the conditions of stimulation were changed so that the test patch was viewed in foveal vision with one eye and the inducing patch with the other eye, the threshold intensity of the test patch was found to be unaltered. This result is interpreted as indicating (1) that the effects noted in the monocular experiments are peripheral (perhaps retinal) in origin, and (2) that we have no physiological evidence for the existence of "corresponding points."

Recent developments in the electrophysiology of spinal cord conduction indicate that a consideration of the time-relations of excitations may be important for the interpretation of reflex mechanisms (Gasser and Graham, 4; Hughes and Gasser, 7; Eccles, 3; and others). For this reason an interpretation of the results obtained in the experiments reported here has been advanced in terms of the known time-relations and properties of the complex retinal potential (Beitel, 2).

REFERENCES

1. Beitel, R. J., Jr. A new conception of the nature of the visual threshold. *Trans. Amer. Acad. Optom.*, 1935.

2. ———. Inhibition of threshold excitation in the human eye. *J. Gen. Psychol.*, 1936, 14 (in press).

3. Eccles, J. C. Inhibition in the superior cervical ganglion. *J. Physiol.*, 1934, 82, 25 P.

4. Gasser, H. S., and Graham, H. T. Potentials produced in the spinal cord by stimulation of dorsal roots. *Amer. J. Physiol.*, 1933, 103, 303-320.

5. Geldard, F. A. Flicker relations within the fovea. *J. Opt. Soc. Amer.*, 1934, 24, 299-302.

6. Graham, C. H., and Granit, R. Comparative studies on the peripheral and central retina: VI. Inhibition, summation, and synchronization of impulses in the retina. *Amer. J. Physiol.*, 1931, 98, 664-673.

7. Hughes, J., and Gasser, H. S. Some properties of cord potentials evoked by a single afferent volley. *Amer. J. Physiol.*, 1934, 108, 295-306.

8. Roaf, H. R. The influences of coloured surrounds and coloured backgrounds on visual thresholds. *Proc. Roy. Soc. London*, 1932, 110B, 448-482.

9. Spencer, L. T. The validity of Heymans' law. *Amer. J. Psychol.*, 1925, 36, 427-433.

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AN ANALYSIS OF FIFTEEN CASES OF SUB-NORMAL VISION*

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The fifteen cases of sub-normal vision here reported are presented with a view to depicting the scope of sub-normal vision work with respect to previous pathology or other etiological factors, refraction, age, visual acuity, duration of sub-normal vision, patient interests and background. It is not intended to show classifications of visual sub-normals, but rather to suggest that the many variables that enter into the situation make each case of sub-normal vision a distinct and relatively new problem in itself. It will also be seen that the actual device used as well as other phases of the treatment are influenced by other considerations than the pathology or state of visual acuity.

With this in mind, no attempt is made to report each case in detail; and a few cases which were previously discussed in detail, are reported here from a different viewpoint. Where the term "First V.A." is used, it signifies the patient's habitual visual acuity at the time of the first examination—with correction if the patient habitually used a correction, otherwise uncorrected. By "Corrected V.A." is meant the visual acuity with the lenses or devices prescribed at the time treatment was completed. For brevity in the case reports "SNV" is used for "sub-normal vision," and "Pathology" will be understood to mean previous pathology, abnormal state of tissues due to previous pathology, or both.

Case 1. (Previously reported[1].) Patient male, age 13. Duration SNV—from infancy. Background: "Born blind," surgical intervention at nine months, no correction; lived with parents until 8 years of age; attended regular school for two years; at age of 8 became inmate of institution for the blind, learned Braille, was forbidden use of eyes. Stated he "could not read with his eyes." General intelligence, above average. Chief interest to be able to read and to take his place in the classroom with normal boys and girls.

First V.A. R. 10/100 L. 10/200.

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Pathology: R. Nebular corneal scar, iridectomized pupil, congenital cataract. L. Leukomatous corneal scar, anterior synechiae, iridectomized pupil, congenital cataract.

Etiology of SNV: Irregular refracting surfaces, non-homogeneous media.

Refraction: R. +1.00⌒+1.50 x 180 L. —2.00.

Treatment: For general use, lens correction; for school and other special distance purposes, wide angle T.S. 1.7x, with add for all near vision. General visual training and rehabilitation, six months.

Corrected V.A. (with T.S.) R. 10/40 L. 10/100

Results: Can read print of any size, write, read music, draw, tool leather. Goes about with greater assurance, despite negligible improvement in measurable visual acuity from lens correction. Removed from institution for blind.

Case 2. Patient male, age 57. Duration SNV—9 months.

Background: Occupation, salesman; normal vision until recently, vision now poor, especially on bright days; previous optometric care, lens correction. Chief interest, better vision for walking and reading.

First V.A. R. 2/200 L. 20/33

Pathology: R. Complete senile cataract. L. Partial senile cortical cataract.

Etiology of SNV: Non-homogeneous media.

Refraction: R. —11.00 L. Emmetropia.

Treatment: Multi-aperture spectacles in fitover form to be used when lighting conditions required them, until such time as surgical intervention is indicated. (Bifocal lens correction.)

Corrected V.A. R. (not corrected). L. 20/25.

Results: Improved vision for walking and reading; can read any size type.

Case 3. Patient female, age 76. Duration SNV—One year.

Background: Retired; existence of cataract in left eye known to patient for 19 years; surgical intervention advised by ophthalmologist "when vision of good eye became very poor." General health poor, patient confined to chair. Chief interest, reading and elimination of annoying—almost painful—light reflexes in left eye.

First V.A. R. 10/30 L. L.P.

Pathology: R. Partial senile cortical cataract. L. Complete senile cataract.

Etiology of SNV: Non-homogeneous media.

Refraction: R. +0.50⌒—1.00 x 90 L. no finding.

Treatment: Lens correction, left lens opaque (lacquered), left side shield. Fitover with horizontal aperture in opaque disc, for right eye for reading. Reading shield.

Corrected V.A. R. 10/20.

Results: Reading made possible. (Optical but not practicable improvement in distance vision—did not warrant special device for other than reading.)

Case 4. Patient female, age 65. Duration SNV—14 months.

Background: Housewife, normal vision until comparatively recently; vision now poor especially on bright days; previous optometric care, lens correction. Chief interest, better vision for reading and walking.

First V.A. R. 20/66 L. 20/50.

Pathology: Bilateral senile nuclear involvement.

Etiology of SNV: Non-homogeneous media.

Refraction: R. $+1.25\bigcirc+0.75$ x 95 L. $+3.25\bigcirc+0.75$ x 85.

Treatment: Multi-aperture spectacles in fitover form to be used when lighting conditions require them, until such time as surgical intervention is indicated.

Corrected V.A. (with P.H.) R. 20/40 L. 20/25.

Results: Patient can read any size type; improved vision for walking.

This case at first glance appears very similar to Case 2. Indeed, the data were presented to bring out the similarity. Yet actually these two cases are extremely dissimilar. In Case 2, the patient was primarily interested in better walking vision, is competing in a gainful occupation with normal sighted individuals and is laboring under the mental strain caused by the practically complete loss of sight of one eye. In Case 4, the patient is primarily interested in reading, her employment is not yet seriously hampered, certainly not threatened, and she still has useful vision with each eye.

Case 5. Patient female, age 46. Duration SNV—8 years.

Background: Left eye "blind" from infancy; loss of vision of right eye does not interfere with patient's going about on street. Disfigurement resulting from deviating left eye and bilateral corneal scars evoked gratuitious advice from friends and acquaintances and even lead to assumption on part of prospective employers that patient's vision was insufficient to meet needs for such simple tasks as kitchen helper. (Whether the reaction of other persons was as marked as is described above—based on patient's remarks—is irrelevant. This is the *real* situation as the patient sees it: she is poignantly conscious of her affliction.) Previous medical attention, no correction. Chief interest, relief of the social situation and removal of interference, from the ocular condition, with opportunities for employment; reading (can read only very large type).

First V.A. R. 20/65 (variable) L. finger count.

Pathology: Bilateral corneal nebulae and cataract.

Etiology of SNV: Irregular refracting surface, non-homogeneous media.

Refraction: No consistent findings.

Treatment: Plano lens correction for general wear. Multi-aperture spectacles for reading

Corrected V.A.: Same as First V.A.

Results: Patient obtained employment in restaurant kitchen, was relieved of annoyance. ("People don't bother me, because although they can see my eyes are bad, they see I have glasses, so they think I see all right.") Can read any size type.

Case 6. Patient female, age 45, widow. Duration SNV—6 years.

Background: Reads newspaper headlines, goes about alone with difficulty. History of having consulted half a dozen outstanding ophthalmologists in various eastern cities, with no appreciable relief. Progress, worse. Lens correction, of no help. Chief interest, reading.

First V.A.: R. 10/50. L. H.M.

Pathology: (Consultation with ophthalmologist) Uveitis, deposits on Descemet's membrane; lenticular and vitreous involvement.

Etiology of SNV: Non-homogeneous media.

Refraction: Negative.

Treatment: Visual training, 3 months, at first with telescopic spectacles. Prescribed (1) for reading, R. +3.00; add +3.00 (upper portion for scanning newspaper); (2) for general use, R. Plano add +2.00; (3) for special near vision purposes, monocular fitover R. +4.00 to be used with (2)—for example, in church.

Corrected V.A.: R. 10/40.

Results: The patient's ability to meet practically all situations requiring near vision has dispelled from her mind the fear of "going blind."

Case 7. Patient male, age 21. Duration SNV—10 years.

Background: Unemployed, of poor Italian family; repeated medical consultations, no treatment; goes about alone, reads newspaper headlines. Vision better on dull days. Chief interests, drive vegetable truck at least on farm; read.

First V.A.: R. 5/200 L. 10/200.

Pathology: R. Posterior cortical lenticular involvement, macular involvement. L. Macular involvement.

Etiology of SNV: Loss of retinal receptors, particularly cones.

Refraction: B. —3.50 x 5.

Treatment: Visual training and rehabilitation, 9 months. Prescribed T.S. 2.2x for special distance vision and for near vision; cylinder T.S. for driving car (sufficient vision for driving, but not in heavy traffic); lens correction for general distance purposes.

Corrected V.A.: R. 10/100 L. 10/77.

Results: Chief interests partially satisfied.

Case 8. Patient male, age 77. Duration SNV—5 years.

Background: Retired. Chief interest, reading.

First V.A.: R. 10/120 L. 10/120.

Pathology: Senile optic atrophy.

Etiology of SNV: Loss of retinal receptors.

Refraction: R. —0.50⊖—1.00 x 90 L. —0.75⊖—1.25 x 65.

Treatment: Lens correction for general distance vision; T.S. 2.2*x* for near vision.

Corrected V.A.: R. 10/50 L. 10/33.

Results: Patient can read newsprint and all other small type.

Case 9. Patient male, age 33. Duration SNV—from infancy.

Background: Occupation, laborer; Porto Rican; withdrawn from school after reaching third grade because of poor vision; deciphers large print. Chief interests, drive car; read newspaper or magazine occasionally.

First V.A.: R. 10/137 L. 10/175.

Pathology: Central retinal involvement, nystagmus.

Etiology of SNV: Loss of retinal receptors.

Refraction: R. +3.00⊖+1.50 x 70 L. +2.00⊖+1.25 x 105.

Treatment: Visual training, particularly reading, 8 months, at first with telescopic spectacles. Prescribed, for distance vision, lens correction; for reading, lens corrections with add +7.00.

Corrected V.A.: R. 10/77 L. 10/77.

Results: The chief interest could not be satisfied, but some improvement in distance vision was effected and reading made possible.

Case 10. (Previously reported in detail[2].) Patient male, age 78. Duration SNV—5 years.

Background: Retired, can read 1½ inch letters. Chief interest, reading.

First V.A.: R. 6/200 L. 6/200 (3%).

Pathology: Senile Choroiditis and atrophy.

Etiology of SNV: Loss of retinal receptors, specifically cones.

Refraction: Negative.

Treatment: Visual training and rehabilitation, 7 months; microscopic spectacles.

Corrected V.A.: (no lenses) R. 6/132 L. 6/132 (4.5%).

Results: Patient reads newspaper daily. After one year the visual acuity (no lenses) is about 10/155 or 6.5%, illumination 20. F.C. As

reported to the Academy last year, this patient can tell time, on a clock at 20 inches (checked to prevent judging time of day).

Case 11. Patient male, age 55. Duration of SNV—50 years.

Background: Occupation, conducts awning and shade business by touch, recognizing patterns by sight, but not colors. "Goes about alone anywhere." Has never read, but was taught alphabet and numbers by mother when sight began to fail. Reads enlarged copies of price lists (figures ½ inch high). Previous ophthalmological examinations. Sole interest, read price lists in original form.

First V.A.: R. H.M. L. 4/200.

Pathology: Optic nerve atrophy.

Etiology of SNV: Loss of retinal receptors.

Refraction: B. +1.50.

Treatment: Microscopic spectacles, visual training two weeks.

Results: Interest satisfied.

Case 12. (Previously reported in detail[3].) Patient male, age 17. Duration SNV—from birth.

Background: "Born blind," surgical intervention, no correction; orphan, inmate of institution for blind 16 years; learned Braille, was forbidden use of eyes; had learned to recognize a few letters; general mental ability, dull normal. Chief interest, work on farm.

First V.A.: R. Totally blind. L. 2/200.

Pathology: L. Partial conical staphyloma, anterior synechiae, iridectomized pupil, possible luxation of lens, opacities of vitreous, choroido-retinal lesions.

Etiology of SNV: Irregular refracting surface, non-homogeneous media, loss of retinal receptors.

Refraction: L. +18.00.

Treatment: Visual training, 2 years; T.S. 1.8x with compound reading addition. The telescopic spectacles were at first used constantly, but are now sometimes replaced by the lens correction.

Corrected V.A.: L. 10/80.

Results: Patient reads magazine print, can go about alone outdoors, both in the city and country.

Compare and contrast Case 12 with Case. 1. Both patients were inmates of the same institution; the pathological histories differ chiefly in degree, which effects the prognosis accordingly; but other even more significant factors are (1) the fact that Case 1 had had some visual experience before confinement to the institution, (2) the difference in intellegence, and (3) the absence in Case 12 of interested relatives in position to remove the patient from the institution.

Case 13. Patient male, age 77. Duration SNV—less than one year.

Background: "Retired" against his will by ill health and the economic pressure which excludes him from even a watchman's job. Because of heart condition, is kept inactive, with result that reading was his only diversion. Advised 6 months ago by his ophthalmologist (consulted regularly over period of years) that no relief was obtainable. For four months has been using four magnifying glasses from the 10 cent store taped together, to decipher print. "Would rather be dead than not able to read." The "chief interest" is obvious.

First V.A.: R. 10/137 L. 10/175.

Pathology: Senile nuclear cataract, bilateral.

Etiology of SNV: Non-homogeneous media.

Refraction: B. —1.50⌒—1.50 x 180.

Treatment: Prescribed T.S. 2.2x for reading. Reading training, one month. Lens correction for distance vision.

Corrected V.A.: R. 10/87 L. 10/122.

Results: Patient reads newsprint. The significance of this will be appreciated if the "Background" of the case is read again.

Case 14. (Previously reported in detail[4].) Patient male, age 64. Duration SNV—2 years.

Background: Resident of Panama, former customs office worker, retired. History of extraction of cataractous lens from the left eye (which he "had not used for reading for 10 years") in 1923, with unsatisfactory results; use of left eye abandoned; successful cataract operation on right eye 9 years later, followed in 8 months by detachment of the retina and total blindness; use of left eye begun; examined by us 8 months later. Could not go about alone outdoors, except under very favorable conditions and then tapping his way with a cane. Deciphered large print with magnifier. Intelligent, cooperative. Chief interests, reading and walking.

First V.A.: R. Blind L. 10/120.

Pathology: R. No fundus reflex. L. Aphakia, disseminated choroido-retinitis.

Etiology of SNV: Loss of retinal receptors.

Refraction: L. +12.00⌒—9.00 x 85.

Treatment: Visual training 1 week. For general distance vision, lens correction in large eye—44x40 mm. For special distance vision (motion pictures, etc.), T.S. 1.8x, with adds for reading and writing.

Corrected V.A. with Rx.: L. 10/80—with T.S. L. 10/30.

Results: Patient enabled to walk about without difficulty under all street conditions, enjoy motion pictures, reading and writing.

It will be observed that this patient was given a very large lens, despite the aberrations that exist in a large lens of this prescription. In the previous correction weight and aberrations had been reduced by the

simple device of using lenses about 28 mm. in diameter. The patient was large of stature and prior to the onset of sub-normal vision had enjoyed normal vision and normal fields for over 60 years. For this reason it was decided that a large field was desirable despite other factors. The patient's reactions confirmed this judgment. These circumstances may be contrasted with those of the next case, in which a small field was used.

Incidentally, it might be pointed out that the patient did not place great value on the vision which he possessed when he first consulted the doctor. This, it will be remembered, was 10/120—much better vision than we obtain after treatment in some cases of sub-normals. But what this patient thought of it is evidenced by the fact that when he was given pencil and paper and asked to write his name, the first day he had his telescopes, he did so and then wrote "I am not blind any more." This may serve to emphasize the importance of interpreting our technical results through the mind of the patient.

Case 15. Patient female, age 37. Duration of SNV—30 years.

Background: Goes about alone with great difficulty; can read newsprint at 1½ inches from eye; school to 7th grade, although she had to leave her seat to see anything on the blackboard; at 18, however, operated power machine in a factory; first lens correction at 23 (O.U. —9.00), still used, but not of much help; repeated ophthalmological examination, observation and local medication. Chief interests, getting about in house and on street, reading.

First V.A.: R. 4/200 (2%) L. L.P. (with Rx).

Pathology: Dull hazy corneae, posterior synechiae, general involvement of the crystalline lenses.

Etiology of SNV: Non-homogeneous media. (Loss or distribution of retinal receptors?)

Refraction: R. —30.00.

Treatment: Lens correction for general use, in myodisc form, 20 mm. center, decentered 2 mm. down. Wide angle T.S. 1.7x for reading.

Corrected V.A.: R. 10/68. (Illum. 20 F.C.) 10/52 (19%) (Illum. 180 F.C.).

Results: Patient reads and goes about with ease.

In addition to the comparisons and contrasts brought out in the discussion, the reader will undoubtedly find many others readily discernible. It is hoped the data have been presented in a manner so as to facilitate such analysis.

* * *

Many inquiries have been received concerning the case of homonymous hemianopsia reported to the Academy two years ago.[5] The patient, now in her eighty-fourth year, continues successfully to use the mirror spectacles. She leads an exceptionally active life, reads many books in the

course of the year and engages in a wide variety of activities, including leading a study club. Observations have been made from time to time which it is hoped may lead to a better understanding of this type of case.

REFERENCES

1. Jaeckle, Charles E., "Case Report—Sub-normal Vision," The Optometric Weekly, February 1, 1934, Vol. XXIV, No. 50, p. 1388.

2. Jaeckle, Charles E., "Restoration of Reading Ability in Both Eyes After Visual Training of One Eye," Transactions, American Academy of Optometry, Vol. IX, 1934.

4. Jaeckle, Charles E., "Sub-normal Vision—Aphakia with Choroiditis," The Optometric Weekly, February 15, 1934, Vol. XXIV, No. 52, p. 1449.

3. Jaeckle, Charles E., "Sub-normal Vision from Infancy," Transactions, American of Academy of Optometry, Vol. VIII, 1933, pp. 71-83.

5. Jaeckle, Charles E., "Optical Correction of a Case of Homonymous Hemianopsia," Transactions, American Academy of Optometry, Vol. VIII, 1933, pp. 17-24.

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ILLUSTRATED AND GRAPHIC RECORD CHARTS

For some time the writer has been dissatisfied with the word picture descriptions of certain ocular conditions of some of my patients as contained in my record charts. While using a large size chart with all of the usual spaces for the more frequently used diagnostic and refractive examination procedure printed thereon, I have found in a rather large number of cases that no set form or no series of words printed on the chart gave just what was needed. To be sure this sort of thing did well in many cases, but these were the very cases which were apt to give little or no trouble and therefore these particular record charts were but little used, and therefore no matter how well these very charts were made out, it was of no particular moment, as they were but seldom used or referred to. The more serious ocular cases on the other hand, which required much training or treatment attention, and which also required much attention to every recorded detail and who in many cases had some sort of a progressive condition, were the very cases in which the elaborate type set chart served little or no useful purpose. With this in mind I began to cast about for a more suitable form of chart which could and would enable me as an optometrist to develop a case record as the case progressed which would give me not only all of the refrac-

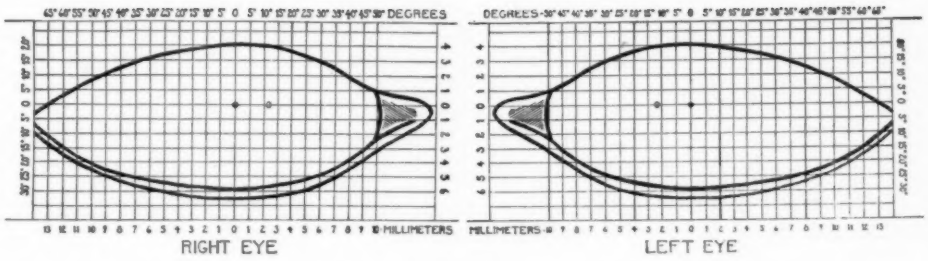

Figure 1

tive data as recorded on any given examination date, but would also give me many things of importance now entirely missing on the chart then in use. To be sure such data as case history, a record of the previously used correction, the uncorrected and corrected visual acuity, the various phoria findings, the corneal reading of the ophthalmometer, the static and dynamic skiametric findings, the results of the subjective tests at near and far, the accommodative tests and the duction readings in both the examination proper as well as in the post-refraction, would, of course, have to be recorded in the usual manner. These findings were for the most part recorded in figures and could, with a good deal of satisfaction, be recorded in their proper place on any well developed chart. It was not here that I was having the trouble. It was rather in attempting to record the data as developed in making the external ocular inspection and the ophthalmoscopic examination that the recording trouble developed. To be sure in the absolutely normal case it was easy to write the word *normal* under each proper heading, but even then, just what did normal mean when the chart was referred to some six months or several years later on? This was also true with the cover test and the findings to be recorded after taking the versions. Just try and describe in words the results of any existing abnormality found in making these important diagnostic tests. If an accurate word description is

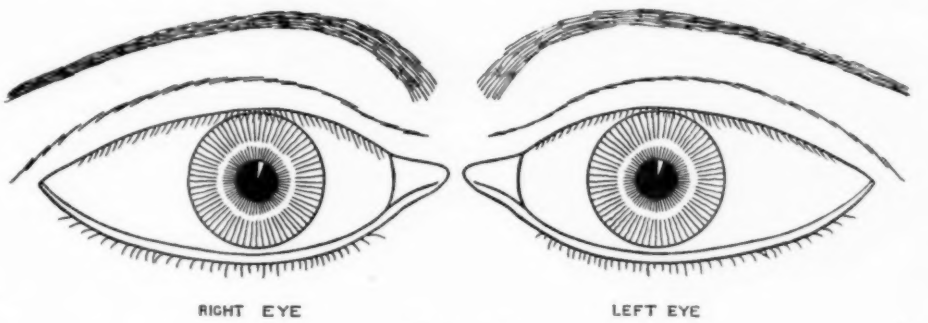

Figure 2

attempted, and this will run frequently to several hundred words, will this description mean much on some later occasion? I doubt it, and as I have tried it many, many times and found the word pictures to lack something which seemed simply must be supplied if my record charts are to be what I believe they should be. Therefore, because of this lack I began to experiment with other means of recording some of the data I felt I wanted to have in each case record.

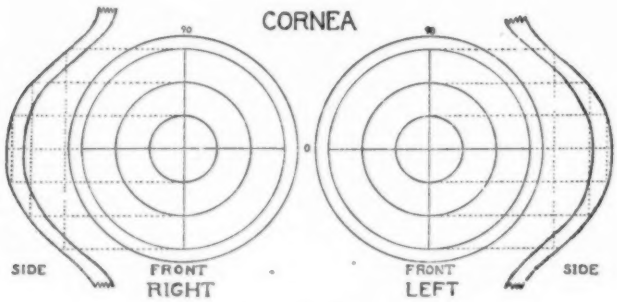

Figure 3

My first experiment failed in a sense. In this, I attempted to remedy the defect of the old chart by merely leaving blank spaces at certain portions of the chart, and then with pen and ink draw, or attempt to illustrate, the results of the tests or the conditions as I found them on that particular date. Not being even a fair artist, these attempts were far from satisfactory. In black and white these crude sketches seldom resembled the existing abnormality I was attempting to record, yet even these sketches were found to be more helpful than the previously used word pictures in bringing back to mind the particular details of the case at a later date. This form of case recording, however, soon led to a more satisfactory type of case charting which is the subject of this paper.

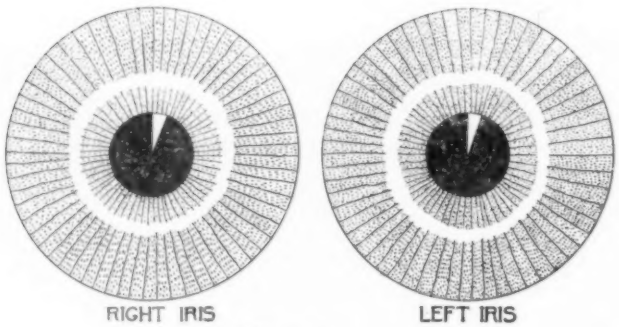

Figure 4

After considerable thought and some investigation I commissioned our staff artist to prepare a series of drawings from which zinc etchings were subsequently made. These etchings then appeared in appropriate places on the new record chart and served as guides and background for further additions sketched or painted over them by myself in either pen and ink, colored crayons or water colors. These etchings appear with this paper and their use will now be described.

Figure 1. Chart to be used in conjunction with the cover test. Before describing the chart itself, it may be well to say something about this simple and very valuable diagnostic test, which I believe should be made at the very start of every ocular examination as it puts the examiner on guard in many cases and explains much which will follow as the examination routine develops. Because of the simplicity of the cover test and because it is not included as a test in some of the now popular and

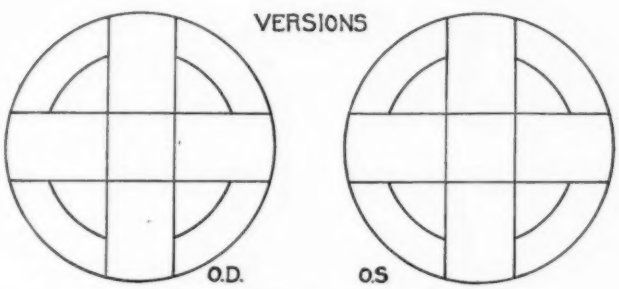

Figure 5

greatly recommended refractive routines, many optometrists have either discarded its use or have forgotten that the test itself ever existed. In my refractive procedure the test is always made, coming at the following point in the examination on the first day of the examination. After the patient's occupation and chief hobbies have been recorded, a record is then made of the patient's uncorrected visual acuity, following which the cover test is made. This test is made as follows: The patient is told to fix the end of a pointer held about eighteen inches directly before the patient's eyes. While the patient is fixing the end of the pointer, I then cover one eye with a small card, and a moment later quickly withdraw the card, observing at the same time the position and movement of the eye which has just been uncovered. If the patient's eye moved inward toward the nose, to again fix the end of the pointer there must have been an outward tendency of that eye when under cover; in other words, indicating an evidence of a convergence insufficiency existing in this case. On the other hand, if the eye just released from the cover had moved outward toward the temple to again fix the end of the pointer we then have evidence of an over stimulation to the internal extra ocular muscles.

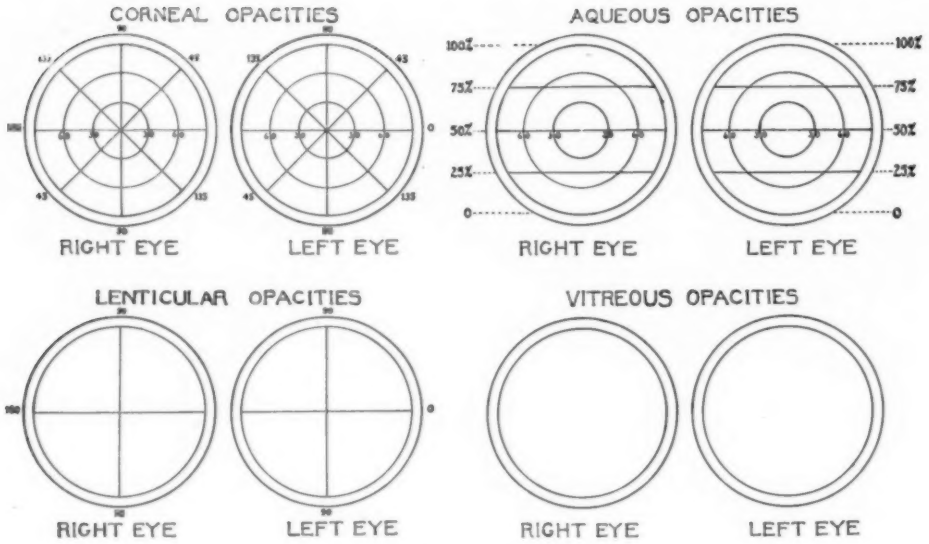

Figure 6

The same test can be, and should be, made with the patient fixing a small light at six meters. These simple tests present the optometrist with information of value and data which should be recorded, and here is where the chart illustrated in Figure 1 becomes of value. The drawing illustrates the right and left palpebral aperture upon which have been drawn horizontal and vertical lines to represent an approximate scale. The figures at the bottom and inner side of each chart represent in millimeters the approximate deviation of the eye under cover while the figures at the top and outer sides represent the number of degrees of deviation, each millimeter representing approximately 5 degrees of deviation[1]. The solid black dot near the center of each aperture represents the normal position of the eye when fixing at six meters. The circle situated somewhat nearer the inner canthus of each eye represents the normal when fixing the end of the pointer held at eighteen inches before the patient on a level with his eyes. The chart is used as follows: After the test is made on a patient where no appreciable deviation is noticed, the solid black spot representing normal for distance is encircled in green with a green crayon. The same is done in red with the open circle, using for this purpose a red crayon. Should any deviation be noted, the red and green marks are placed in their proper points on the scale where the eye was observed to go while under the cover test. Colored lines are then drawn from these points to the normal points to indicate the type and approximate amount of the deviation observed in making these cover tests. The recording is thus done easily and the observing quite accurately

after a little practice. This chart is also of great value in diagramming the position of the eyes in squint cases, the deviation from normal being easily shown on the graph.

Figures 2, 3 and 4 are used in conjunction with the external ocular inspection. Abnormalities of the lids and lid margins can easily be sketched in on the line drawing of Figure 2 which with a few simple words of written explanation will go far towards leaving an adequate record of the condition on the date seen. The same is true with reference to the orbit, lacrymal glands, sclera, conjunctiva and inner canthus. The cornea is dealt with in Figure 3, space being provided to enable one to easily sketch any evidence of ulceration, scars, inflammation, foreign bodies or vascularization, locating these in color in their true position from both a front and side view as seen with focal illumination and the slit-lamp. Figure 4 deals with the iris as observed during the external ocular inspection, this background drawing serving as a chart upon which can easily be drawn in true colors any points of interest seen while viewing the iris. With the use of white as well as black india ink exudates, malformations of the pupil, adhesions and any changes in the size and shape of the pupil can be recorded as seen, these later on being colored in, in the true colors of the iris, thus making a record which is both accurate, interesting and of some future value. At the side of Figure 4 in the chart itself spaces are provided for notations regarding the size of the pupil as well as its response to both light and accommodation.

Figure 5 deals with the versions. Upon this chart a record of the versions is easily made as follows: In the normal case in which each eye readily and smoothly rotates through its full arc, straight horizontal and vertical lines are drawn through the pathways bisecting the circle

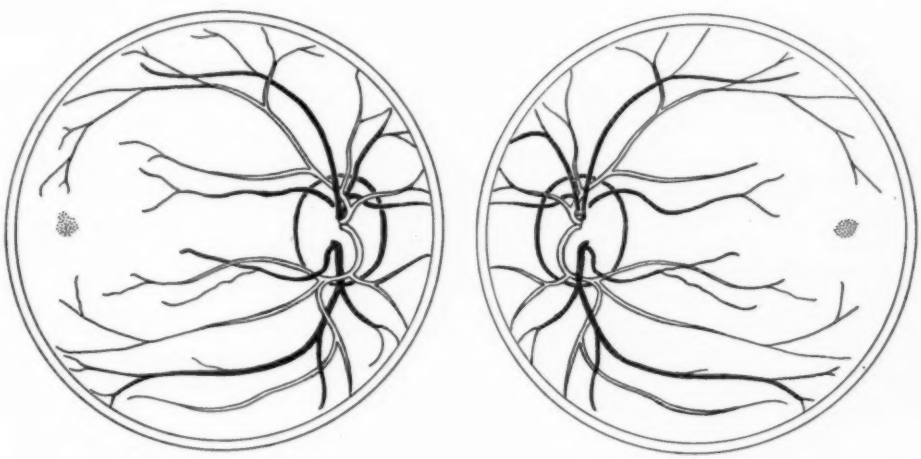

Figure 7

representing the full rotating arc of each eye. In the subnormal case the line is so drawn on the chart as to indicate the limits of the ability of that eye to move. Should the eye movements be jerky instead of smooth, the line drawn on the chart is also made jerky and uneven, instead of straight, indicating that the versions were for some reason impaired. This test is one which takes but a moment or so to make and is of such importance that I believe it should never be omitted from the routine of an ocular examination, yet many of my colleagues, to my knowledge, do not bother to make it and for that reason I will briefly review the simple technique employed in making this portion of an examination. The test is made in two parts. Part one consists of having the patient follow with both eyes the end of a pointer as it is moved in the horizontal and vertical meridians before the patient. The patient being instructed to move the eyes and not the head. Part two consists of the same technique, the examiner, however, watching the movements of the eye occluded behind a card held six inches before one eye while the patint follows the end of the pointer with the uncovered eye. In squint and amblyopic cases Peckham[2] suggests using a small red lamp as a fixation object instead of a pointer.

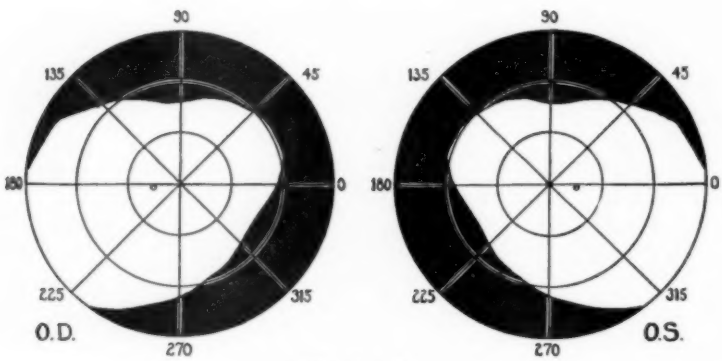

Figure 8

Figures 6 and 7 deal with the ophthalmoscopic examination. In Figure 6 spaces are provided to sketch in the chart, in india ink, opacities as seen in either the corneal media, the anterior chamber, the crystalline lens or the vitreous. The use of these four charts is so obvious that further explanation would be unnecessary. The data so recorded, however, is of great value in subsequent examinations, particularly in cataract cases seen in their early stages. Here, too, of course, care must be taken in making the examination as well as recording the findings if the record is to be of value. Figure 7 will be recognized as a sketch of the right and left fundus and serves as a background for the drawing in of fundus

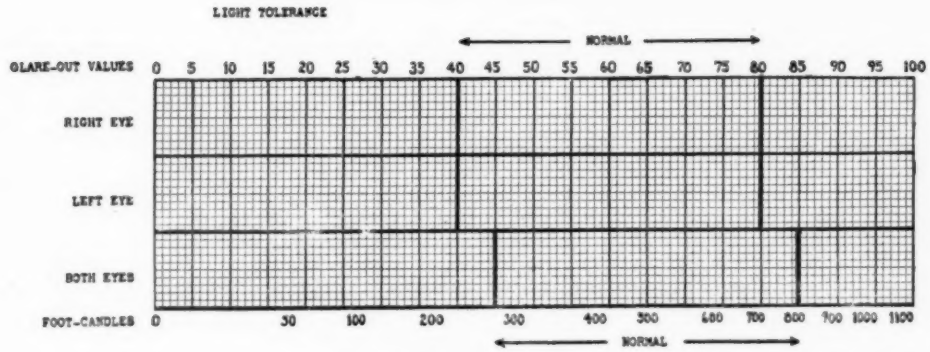

Figure 9

changes as observed in making the ophthalmoscopic examination. These can be sketched in this background with either ink or colored crayons and should the examiner wish to go to the trouble, the entire fundus could be colored in, in its true color, with water colors. These two charts serve to a very marked degree to enable an examiner to carefully record any departure from normal in a manner far better than the written word.

Figure 8 is used to record the results of field charting, the perimetric findings being recorded in either colored inks or colored crayons in the usual manner, these small charts eliminating the need for attaching the regular large size perimeter charts to the record.

Figure 9 is included in this discussion, not because of its importance, but rather to indicate that a similar method of recording refractive data might easily be carried on to graphically record other findings as developed in the course of an ocular examination. This chart is used in conjunction with the glare-out tests, the top figures being the glare-out values as indicated on the glareometer and the lower figures being the foot candle values from the Sheard[3] formula. The recording in this case being easily accomplished by simply placing a small dot or cross in each of the three horizontal lanes at the glare-out point.

This type of record keeping in optometric procedure does much to relieve the monotony of making many various ocular tests each day; it is also doing much to make each refraction more interesting as the recorded findings developed, as the refraction proceeds, prove to be a stimulating force to greater accuracy. The chart of each case really becomes a record which has permanent value and which can be referred to at a later date with confidence.

Carel C. Koch.

BIBLIOGRAPHY

1. James Thorington. Refraction and How to Refract. P. Blakiston's Son and Company, Philadelphia, Pa., page 204, 1913.
2. Ray Morse-Peckham. Squints and Heterophorias. Volume I. Published by the author at 11 Monterey Parkway, Rochester, N. Y., page 92, 1931.
3. Charles Sheard. Glarometric Measurements on Ocular Photosensitivity. American Journal of Optometry, Volume XIII, No. 8, pages 281-289, 1936.

BOOK NOTICES

DISEASES OF THE EYE. Sir John Herbert Parsons, C.B.E., D.Sc., F.R.C.S., Consulting Ophthalmic Surgeon, University College Hospital, London. Eighth Edition. Published by the Macmillan Company, 60 Fifth Avenue, New York City. 705 pages, 381 illustrations and colored plates, cloth, $5.50, 1936.

This is the eighth edition of this fine book on ocular pathology and is the fifth edition to come forth in the last ten years, which indicates that the work has won a place as one of the valuable texts on this subject, which it really is as it fully covers the subject. Optometrists interested chiefly in the diagnostic phases of ocular work will find here much that is both new and freshly presented and the book is so cross indexed that it becomes a text of great value for rapid reference work in the refracting room. C. C. K.

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FUNDAMENTALS OF HUMAN PHYSIOLOGY. J. J. R. Macleod, M.B., D.Sc., F.R.S., Late Regius Professor of Physiology in the University of Aberdeen, Scotland; formerly Professor of Physiology in the University of Toronto, Toronto, Canada; formerly Professor of Physiology, Western Reserve University, Cleveland, Ohio, and R. J. Seymour, M.S., M.D., Professor of Physiology, Ohio State University, Columbus, Ohio. Fourth Edition. Published by the C. V. Mosby Company, 3523 Pine Boulevard, St. Louis, Mo.; 424 pages, 4 color plates and 108 illustrations; cloth, $2.50, 1936.

For some time the writer has been searching to find a text book on elementary physiology which would fit into the exact picture now facing many of the older optometrists who are attending graduate optometric courses and who frequently are given technical material by speakers at these meetings, which for these oldsters, is somewhat ahead of the educational backgrounds they possess. The fourth edition of the *Fundamentals of Human Physiology* fills this bill admirably. Seymour in this text has presented the subject in such a clear and understandable manner that what seems an involved subject from the pens of some writers is here presented in a way as to be both clear and readily comprehensible. This is a text, not for the advanced student of physiology but rather for the beginner and as such should play an important part in some of the work of our many graduate courses for the older practicing optometrists. This book can be doubly recommended to these optometrists as it fills a need they now lack and does so at the very low cost of but $2.50. C. C. K.

STEDMAN'S MEDICAL DICTIONARY. Thomas Lathrop Stedman, A.M., M.D. Editor of the "Twentieth Century Practice of Medicine," of the "Reference Handbook of Medical Sciences," etc. Thirteenth revised edition. Published by the William Wood Company, Baltimore, Md. Fully illustrated, 1,291 pages, fabrikoid covers. Price, with thumb index, $7.50; without index, $7. 1936.

The thirteenth edition of this revised new work by Stedman gives the user, in a very easily understood manner, the pronunciation and derivation of more than 15,000 modern medical, surgical, pharmacal, dental and other scientific terms, including those used in ocular work and ocular writing. This dictionary has been personally edited for the past twenty-five years by Dr. Thomas Lathrop Stedman, who for many years has been recognized as one of the world's greatest authorities on medical terminology and lexicology.

A book of this character should be at hand in the office of every optometrist to assist him in his reading and study and also to greatly help him in developing papers to be presented at optometric gatherings. It is a necessary reference work for all professional people and fully fills the need for which is was intended. C. C. K.

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BRAIN REFLEXES AND LAWS OF EXISTENCE, William D. Hoffman. Published by the Parkman Press, Los Angeles, Calif. Leather binding, 306 pages, 1936. Price, $10.00.

In this book, "Brain Reflexes and Laws of Existence," Hoffman attempts to unravel the mysteries of psychic activity. In order that one may be able to grasp this very interesting and complex subject, one should have a good working knowledge of the sciences of anatomy, physiology, psychology, psychiatry and philosophy. The author is well aware of this fact and set out to treat some of these complex subjects in this book. He has some chapters on brain anatomy, creation of reflexes, energy, control of energy, mental processes, cortical pathology, functional pathology, suggestion, hypnosis, office technique, etc.

Hoffman tried to cover several difficult and complex subjects in one book, as a result he failed to do justice to anyone of them. The subject matter in each case is of necessity abbreviated and elementary. The author maintains that this book is written for the office practitioner, however, because of the way the subject matter is presented and the lack of proof about the successful results obtained in the many difficult cases mentioned it appears to the reviewer that the author missed his mark, and that the book will be of more value to the layman than to the practitioner. J. I. K.

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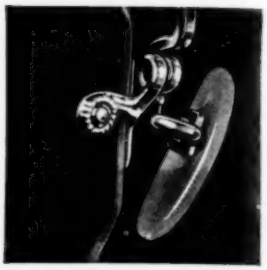

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